

AN ACCOUNT OF SOME FILARIAL PARASITES OF
AUSTRALIAN MARSUPIALS

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[Read 12 May 1938]

The collection of Filarial parasites from Australian marsupials at present under consideration was obtained chiefly in Queensland, New South Wales and Central Australia. References to recorded occurrences of these and other entozoa from this order of mammals in the Australian region were brought together by one of us (Johnston, 1909, 1911, 1916), but many were listed merely as *Filaria* sp. Oldham (1933) gave a list of the entozoa reported from Australian and American marsupials.

In the present paper four species of *Dipetalonema* are described as new (*D. dasyuri*, *D. rarum*, *D. annulipapillatum* and *D. tenue*), and an account is given of *D. roemeri* (Linstow), *D. spelaea* (Leidy), and *D. trichosuri* (Breinl). Brief reference is also made to female specimens, listed as *Dipetalonema* sp., and *Filaria* (s.l.) spp., from four different host species. Of the filariae already described from Australian or New Guinea marsupials, three species have not been identified amongst our material—*Brcinlia dendrolagi* Solomon, 1933, described from *Dendrolagus inustus* (New Guinea); *Filaria dentifera* Linstow, 1898, from *Trichosurus vulpecula* (Queensland); and *Dipetalonema capilliforme* Baylis, 1934, from *Dasyurus hallucatus* (North Queensland).

The various parasites studied in the present paper are listed under their respective hosts as follows:—

- Macropus major* Shaw—*Dipetalonema roemeri* (Burnett River, Queensland).
Macropus robustus Gould—*D. roemeri* (Cockatoo Creek and Mount Liebig, Central Australia); *D. tenue* n. sp. (Cockatoo Creek and Mount Liebig, Central Australia).
Macropus parryi Bennett—*D. roemeri* (Burnett River).
Macropus melanops Gould—*D. roemeri* (North Western Australia).
Macropus dorsalis Gray—*D. annulipapillatum* n. sp. (Burnett River).
Macropus ualabatus Less. and Garn.—*D. roemeri* (Lower Hawkesbury, New South Wales).
Macropus welsbyi Longman—*D. roemeri* (Stradbroke Island, South Queensland).
Dendrolagus lumholzii Collett—*Dipetalonema* sp. (? *roemeri*) (North Queensland, from Melbourne Zoological Gardens).
Dendrolagus bennettianus De Vis—*D. spelaea* (North Queensland, from Sydney Zoological Gardens).
Petrogale penicillata Gray—*D. spelaea* (Burnett River).

Onychogale frenata Gould—*Dipetalonema annulipapillatum* n. sp. (Burnett River); *D. rarum* n. sp. (Victoria); *D. roemeri* (Burnett River).

Trichosurus vulpecula Kerr—*D. trichosuri* (Burnett River).

Trichosurus caninus Ogilby—*Filaria* (s.l.) sp. (Townsville, Gosford, Lower Hawkesbury River, New South Wales).

Potorous tridactylus Kerr—*Filaria* (s.l.) sp. (Dorrigo, New South Wales).

Dasyurus maculatus Kerr—*Filaria* (s.l.) sp. (Brisbane).

Dasyurus viverrinus Shaw—*Dipetalonema dasyuri* n. sp. (Victoria).

The last-named two hosts belong to the Polyprotodontia, all the others to the Diprotodontia.

The host name *Macropus major* has been used instead of *M. giganteus*, of which the former has long been regarded as a synonym. The confusion regarding the correct name of the Great Kangaroo has been discussed by Iredale and Troughton, who have pointed out that *M. major* Shaw is the correct name for it. *M. giganteus* of Erxleben and of Zimmermann belongs to the species seen by Captain Cook in the vicinity of what is now Cooktown, North Queensland, this species being a much smaller form, in fact, a wallaby, *Wallabia cangaru* Muller, 1776, whose range extends northwards to Cape York Peninsula (Iredale and Troughton, Mem. Austr. Museum, 6, 1934, 55; Rec. Austr. Museum, 20, (1), 1937, 67-71). In our paper we have not utilized the subdivisions of the old genus *Macropus*. We take the opportunity to correct an error in Linstow's paper (1898) dealing with some parasites collected in the Burnett River region by Semon: the name *Dasypus hallucatus* should be *Dasyurus hallucatus*, sloths (*Dasypus*) being absent from Australia. The parasite referred to by Linstow was a larval nematode, recorded, perhaps incorrectly, as *Ascaris* sp.

We desire to acknowledge assistance in regard to material from the late Dr. T. L. Bancroft and from his daughter, Dr. J. M. Mackerras, for specimens from the Eidsvold district, Upper Burnett River, Queensland; Mr. A. S. LeSouef, Director, Taronga Zoological Park, Sydney, for worms from *Dendrolagus* and *Potorous*; Professor O. W. Tiegs, University of Melbourne, for specimens from *Dasyurus viverrinus*; and our colleague, Professor J. B. Cleland, for parasites from *Macropus melanops*. The remaining material was collected by the senior author, much of it during the various anthropological expeditions to Central Australia (1929-1937).

Types of new species have been deposited in the South Australian Museum, Adelaide.

Wehr (1935, 87) erected the family Dipetalonematidae (Syn. Dirofilaridae Sandground) to receive two subfamilies, Dipetalonematinae (to include Onchocercinae Leiper as well as Loainae and Setariinae Yorke and Maplestone (in part), and Dirofilarinae (a new subfamily for *Dirofilaria* and *Loa*). Chitwood and Chitwood (1937) have accepted, in part, Wehr's classification. We regard Dipetalonematidae as a synonym of Sandground's family, which has priority. We follow Baylis (1934) in using *Dipetalonema* instead of *Acanthocheilonema*.

Dipetalonema dasyuri n. sp.

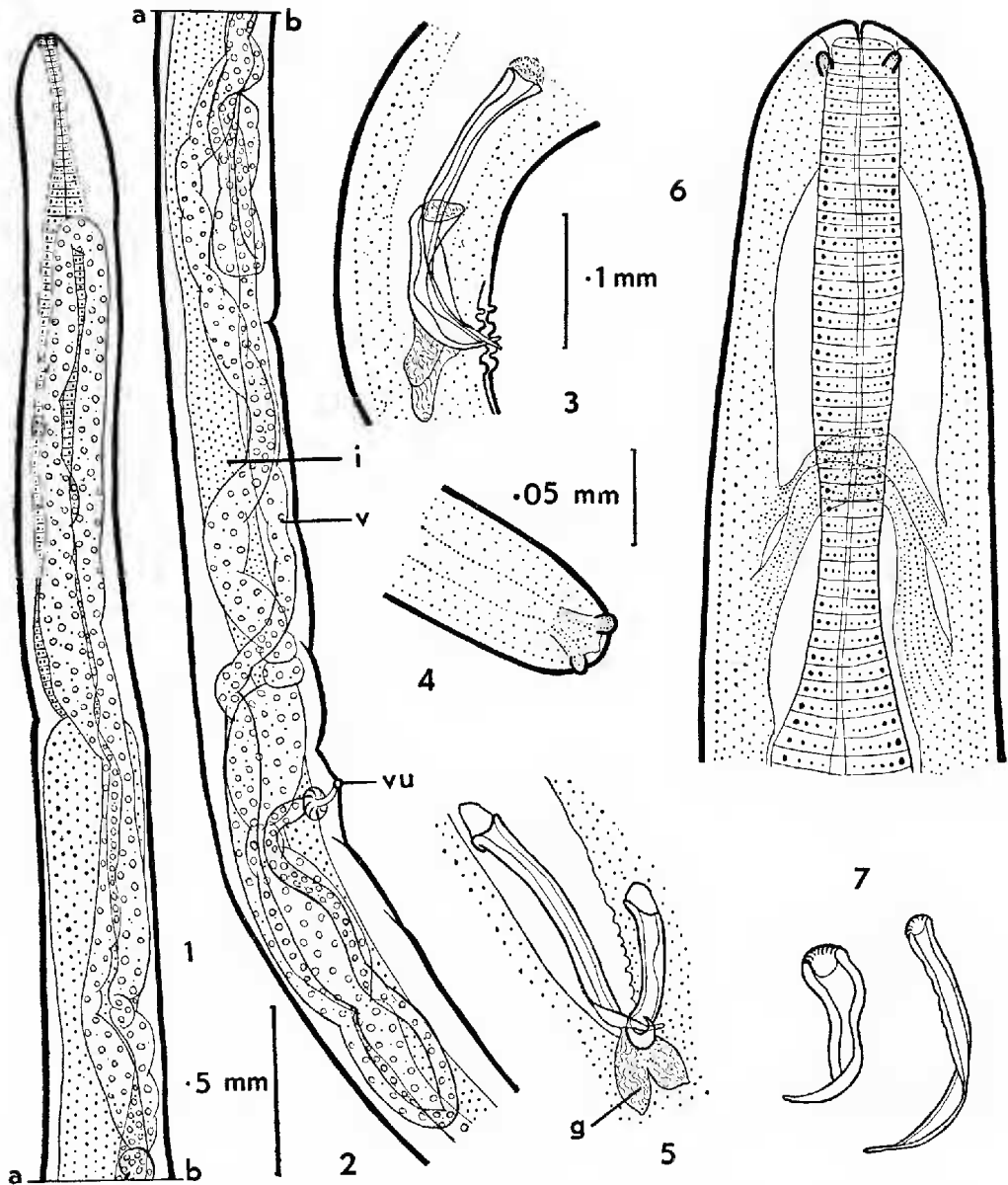
Figs. 1-7

The specimens occurred in large numbers in the body cavity of a "native cat," *Dasyurus viverrinus*, from Victoria. They are long, slender and much coiled. The head is the shape of a truncated cone. There is a tapering tail on which are a pair of sub-terminal papillae. A little back from the anterior extremity are two pairs of large papillae, 0.008 mm. long in the male.

The male attains a length of 20 to 40 mm., and a maximum breadth of 0.17-0.26 mm. The head at its widest part is 0.1-0.13 mm. wide, and the breadth taken just in front of the cloaca 0.092-0.1 mm. The cuticle at about the middle of the body is 2.7μ thick. The nerve ring is 0.16-0.22 mm. from the anterior end. The tail region is coiled in a close spiral of three or four turns. The cloaca is 0.4-0.5 mm. from the posterior end, so that the tail is one seventy-fifth of the body length. Around the cloaca are four pairs of papillae, two pre-anal and two post-anal. The spicules are unequal, one being 0.12 mm. and the other 0.2 mm. long. They are of approximately the same shape, cylindrical at the upper or proximal end, spatulate and curved at the distal end, to terminate in a point which is more drawn out in the longer spicule. The testis tubule begins in a swollen portion just posterior to the oesophagus, and is straight for some distance, then coiled. The wide oesophagus consists of an anterior narrower portion, 0.29 to 0.32 mm. in length, and a longer wider region 1.1 to 1.2 mm. in length, *i.e.*, about one twenty-eighth of the body length. The straight intestine is relatively wider in the male.

The female dimensions vary considerably with age. The adult is 83 to 97 mm. long, with a maximum breadth of 0.36 to 0.37 mm. The head is 0.2 mm. wide, and the cloacal region 0.12-0.15 mm. The tail is 0.35 to 0.7 mm. and bears, like the male, a pair of subterminal papillae, 0.01 mm. long. The cuticle is $13-19 \mu$. The nerve ring is about 0.21 mm. from the head end. The anterior part of the oesophagus is about 0.28-0.38 mm., and the longer succeeding portion 1.7-2.1 mm., *i.e.*, about one forty-sixth of the body length. The vagina is much coiled in the adult, extending forward almost to the anterior end, then bending back and curving around the position of the vulva, ending in a muscular enlargement from which a narrow tube leads to the exterior. The vulva in the adult female divides the body from head to tail in the ratio 1:15, in young females the ratio is 1:12. The vagina leads into the uterus and this divides into two uteri which become continuous with the oviducts towards the posterior end. The coils of the ovarian tubes extend almost to the tip of the tail. The uterus is packed with eggs, and among these was found one larva. The eggs are 25μ by 21.5μ , and the larva 0.15 mm. long and 0.009 mm. wide.

The species differs from *D. roemeri* and *Filaria australis* in having sub-terminal papillae, also in the number and arrangement of the anal papillae in the male, and in the dimensions of the worms; from *F. dentifera* Linstow in the absence of a dorsal papilla on the head, in being much shorter (especially the males), in the position of the vulva, and in the number of cloacal papillae; from



Figs 1-7

Figs. 1-7 *Dipetalonema dasyuri* 1, anterior end of female; 2, part of female, continuous with fig. 1 at AB; 3, lateral view of female, cloacal region; 4, posterior end of female, ventral; 5, spicules, ventral; 6, head of male, ventral; 7, spicules. Figs. 3, 5 and 7 are drawn to same magnification; 4 and 6 to scale beside 4

EXPLANATION OF FIGURES

References to Lettering—a, anus; ca, caudal ala; g, gland; i, intestine; l, larvae; o, ovary; oes, oesophagus; od, oviduct; ut, uterus; v, vagina; vu, vulva; vd, vas deferens; wut, wall of uterus.

D. capilliforme in having the oesophagus longer and differentiated into two parts, two pairs of cephalic papillae, the nerve ring further back, tail shorter, spicules relatively of different sizes, the vagina bending forwards and the vulva situated further back. It differs from *Dipetalonema dendrolagi* in the shorter length, relative lengths of two spicules, and the arrangement of the papillae in the cloacal region.

DIPETALONEMA ROEMERI (Linstow)

Figs. 8-13

Specimens have been examined from *Macropus major* (knee joint), *M. robustus* (knee joint and in body cavity), *M. melanops*, *M. dorsalis* (knee joint), *M. parryi*, *M. ruficollis* (tail muscles) and in *Onychogale frenata*.

These agree with Linstow's description, but in view of the large number of specimens examined, his account can now be amplified. As Baylis (1925) has noted, the larger spicule consists of a cylindrical proximal portion and a needle-like distal portion with which is associated inrolled alae. The number of cloacal papillae has been found to be subject to variation, there being usually four pairs of pre-anal, but we have found some with three pairs, others with four on one side and six on the other. There have always been found one pair of adanal, one pair immediately post-anal, and five pairs of lateral papillae, as well as a pair of small papillae near the mid-line behind these.

In the male there are eight papillae around the mouth, arranged in pairs laterally, dorsally and ventrally as in the diagram, and in the female four single papillae in these positions.

In the female the position of the ovarian tubes and oviducts varies with the age of the specimen, appearing in the older ones in the anterior region, even in front of the vulva. The oviducts pass back leading to the uteri which travel to the posterior end of the body, and return, joining near the end of the oesophagus. The vagina which begins soon after this junction, twists about before entering the vulva. The position of this varies with the age, the ratio of the total body length to the distance between the vulva and anterior end varying from 30:1 to 50:1. Females with this difference have been found either together or with the characteristic male of *D. roemeri*, and their general anatomy and dimensions such as the relation of length to thickness, the anterior end, the nerve cord and tail, are similar. The vulva, moreover, in almost all cases bears the same relation to the oesophagus, extending forward from the posterior end for one-half to one-quarter the length of the latter organ.

D. roemeri was described originally by Linstow (1905, 356-8) from material collected from the subcutaneous tissue of *Macropus antilopinus* Gould. No locality, except Australia, was given. The range of this species is the Northern Territory. Linstow quoted some references to *Filaria websteri*, but remarked that no description of it had been published.

In the catalogue of the Royal College of Surgeons, London (1830-37), there is reference to the *Filaria macropi majoris*, worms found in the capsular ligaments

of the knee joint of a kangaroo. Diesing in 1851 altered the name to *F. macropodis gigantei*. Cobbold (1879, 433) renamed it *F. websteri* after its discoverer and mentioned that Bancroft had also found it in the great kangaroo. The latter sent much parasitic material to Cobbold from Queensland, and no doubt this record relates to material from that State. Bennett, in his "Wanderings in New South Wales" (1, 1834, 293), reported finding long thin white filariae encysted in the knee joint of *M. major* in New South Wales. Fletcher (P.L.S., N.S.W., 8, 1883, 388) found *F. websteri* in the same species, also from New South Wales.

Other authors (*e.g.*, Molin, Linstow) have referred to some of the foregoing occurrences. Railliet and Henry in 1910 (C.R. Soc. Biol., 68, 1910, 251) suggested that the species might belong to *Onchocerca*. Yorke and Maplestone (1926, 395) placed it under *Dirofilaria*. T. L. Bancroft (Trans. Inter. Med. Congr. Austr., 1889, 50; Austr. Med. Gaz., 12, 1893, 258) also referred to the parasite from kangaroos, undoubtedly Queensland occurrences. Crisp (P.Z.S., 1853, 68) mentioned the presence of *Filaria* sp. in the knee joint of a kangaroo. Johnston and M. J. Bancroft (P.R.S. Queensland, 32, 1920, 45) referred to its occurrence in the knee joint of *Macropus parryi* and *M. giganteus* in the Burnett River district, embryos having been taken from the blood of the former.

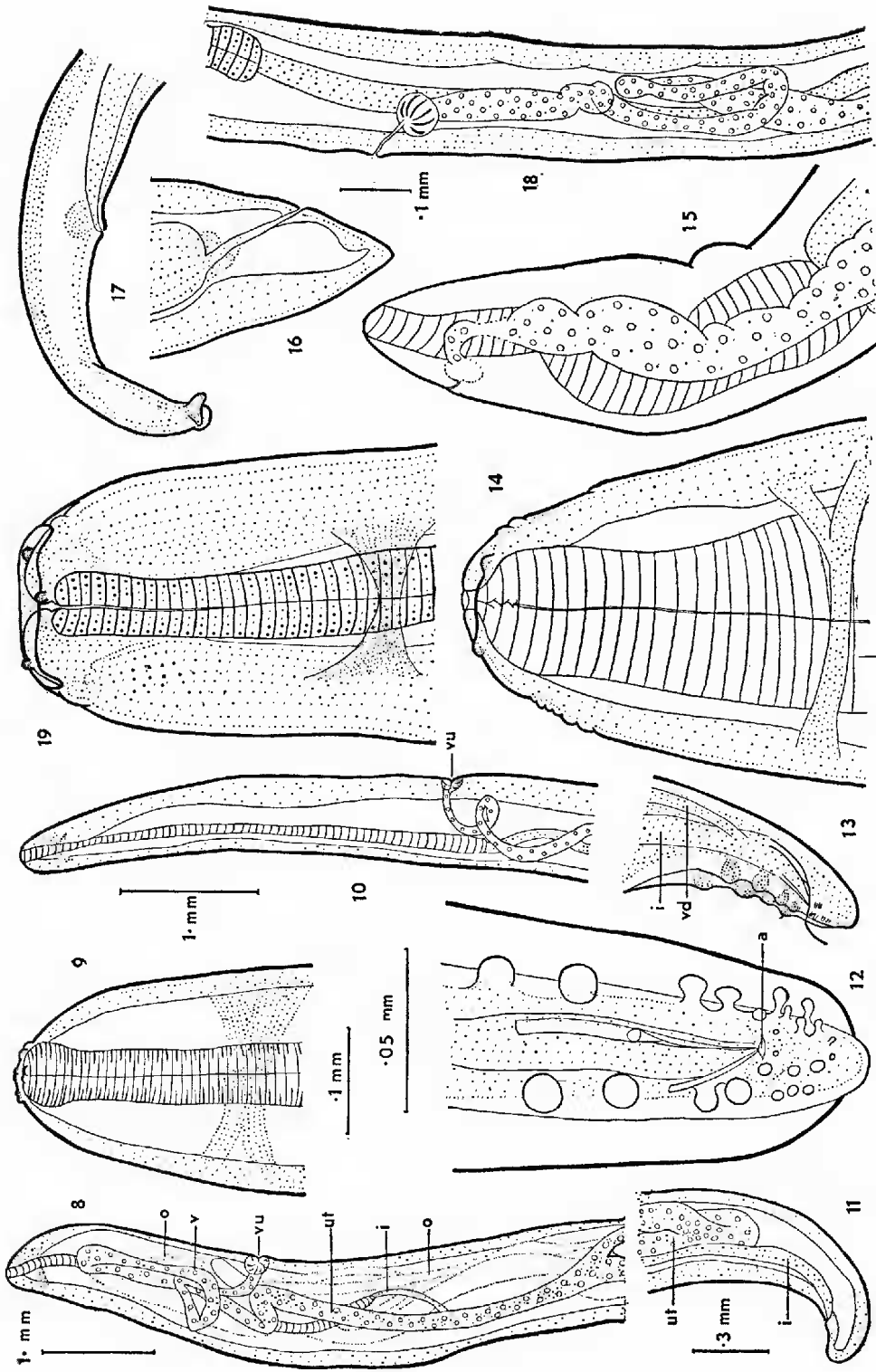
In spite of the numerous references to the parasite, no information regarding it has ever been published, apart from its location in certain species of kangaroos. Its specific name is consequently a nomen nudum. *D. roemeri* is undoubtedly the same parasite, as our experience has shown that it commonly frequents the knee joint of many species of *Macropus*, including the type host for *F. websteri*. Accordingly, we consider that the valid name should be *D. roemeri* (Linstow) instead of *Dipet. websteri* (Cobbold), which has no nomenclatorial standing.

DIPETALONEMA sp. (? D. ROEMERI)

Specimens from the coelome of a tree kangaroo, *Dendrolagus lumholzii*, are all immature females. They are from 6.3 to 9.5 cms. long and 1.38 to 1.69 mm. in maximum diameter. The rounded anterior and posterior ends taper a little, the head being about 0.107 mm. broad and the width in the region of the anus 0.15 to .2 mm. The distance from the anterior end to the nerve ring is about 0.42 mm.

The head has no lips or teeth and only two pairs of small lateral papillae. The walls of the most anterior portion of the oesophageal tube are slightly chitinised. The wide oesophagus is 2.7 to 3.1 mm. long, but is not straight. The intestine is wider, and can be seen by the naked eye as a brown-green line passing down almost to the anus. It narrows suddenly about 0.2 mm. from the anus, with which it is connected by a narrow tube. The tail is very short, 0.13 to .21 mm. long, and bluntly conical.

There is in these young specimens no sign of ovarian tubes, but the uterus and the vagina can be distinguished in the anterior part of the body. The vulva is 0.54 to .6 mm. from the anterior extremity.



Figs. 8-13 *Dipetalonema roemeri* 8, anterior end of female; 9, anterior end of male; 10, anterior end of young female; 11, posterior end of female, lateral view; 12, posterior end of male, lateral view; 13, posterior end of male, lateral view, longer spicule extruded
 Figs. 14-16 *Dipetalonema* sp. from *Dendrolagus himholtsii* 14-15, anterior end; 16, posterior end
 Figs. 17-19 *Dipetalonema rarum* 17, female, posterior end, lateral view; 18, region of vulva; 19, female, anterior end
 Figs. 9, 13, 14 and 17; 11 and 15, 12 and 19; 16 and 18 to same magnification

This must be regarded as an immature form, but its general anatomy, length and thickness agree most closely with those of *D. roemeri*. The oesophagus is, however, wider and somewhat sinuous.

Lumholz in 1884 (P.Z.S., 1884, 409) referred to the presence of parasitic worms in the subcutaneous tissues of this tree kangaroo, which he discovered in Northern Coastal Queensland.

Dipetalonema rarum n. sp.

Figs. 17-19

Specimens from *Onychogale frenata* comprised one whole female, the posterior end of another, and the anterior end of a male. They were taken from small subcutaneous nodules.

The worms are relatively thin and elongated, the female being 51.5 mm. long and 0.187 mm. maximum diameter. The head is rounded, bearing four lips and four small papillae; it is 0.126 mm. wide in the female and 0.059 mm. in the male. The tail is tapering, ending in a rounded point, and bears two rather large subterminal papillae. Across the anus the body width is, in the female, 0.09 mm. The tail is 0.27 mm. long. The oesophagus is 3.15 mm. long in the female and 2.7 mm. in the male. From the anterior extremity to the nerve ring is 0.252 mm. in the male, and 0.12 mm. in the female.

The testis tube starts with a bulb-like portion near the posterior end of the oesophagus and continues to a coiled part about the middle of the body, where it enters the vesicula seminalis; the rest of the body is missing just beyond this level.

The ovarian tubes extend almost to the anus; the two uteri unite a little behind the vulva, one of them being much bent just before this junction. The vagina is slightly coiled, then straight for a short distance before ending in a muscular bulb from which a narrow tube leads to the exterior. The vulva is just behind the posterior end of the oesophagus, being 3.55 mm. from the anterior end.

There is some difficulty in classifying this worm as the posterior end of the male is absent; the head, and the posterior end of the female, indicate the genus, *Dipetalonema*; the papillae of the head and the position of the vulva do not agree with any species so far described.

Plimmer (1912a, 407; 1912b, 137) referred to finding microfilariae in the blood of *Onychogale frenata* in the London Zoological Gardens, but originally from New South Wales. The adult worms occurred in the body cavity of the mother and of the foetus within the pouch. The species may, perhaps, have been *D. spelaea*.

DIPETALONEMA SPELAEA (Leidy)

Figs. 20-24

Leidy, in 1875, gave an account of this species from a "whallabee" as *Filaria spelaea*. Linstow (1897) described a parasite from a rock wallaby (*Petrogale*) as *Filaria australis*. Breinl (1911) described a worm from the body cavity of *Trichosurus vulpecula* as *F. trichosuri*. Leiper (P.Z.S., 1919, 620)

recorded *F. australis* from a wallaby in London Zoological Gardens. Walton (1927, 111-113) re-examined Leidy's material and found it to belong to the same species as Linstow's, hence Leidy's name should stand. Baylis (1925) described a filariid from the common opossum, *Trichosurus vulpecula*, which resembled *F. australis* Linstow (or *F. spelaea*), except that the major spicule was much shorter and there was a difference in the anal and the caudal papillae, but decided that his material belonged to Linstow's species which he placed in *Acanthocheilonema*. Boulenger (1928) stated that he had examined specimens from *Halmaturus* sp. (i.e., a wallaby) which agreed very closely with Linstow's, but not with Baylis's description. He concluded that Baylis was dealing with a form closely allied to, but distinct from, Linstow's species. Oldham (1933, 30) listed the parasite as *Setaria spelaea*, as also did Railliet and Henry (1911). Thwaite (1927, 465) republished Leidy's account.

In 1934 Baylis published a list of synonyms of *Dipetalonema spelaea* (Leidy), including *F. australis* Linstow, *F. trichosuri* Breinl, 1913, and *Acanthocheilonema australe* Baylis, 1925. He stated that the most important difference lay in the length of the major spicule, and he assumed that this feature was variable within the species.

We have examined numerous worms from *Trichosurus vulpecula* and from *Petrogale penicillata*, and find that in males from the latter host the major spicule is always long, agreeing with Linstow's account, but that in those from *Trichosurus* it is short, agreeing with Breinl's description. The difference in size, moreover, is so great that we are unable to agree with Baylis in his identification, and we agree with Boulenger that there are two closely allied species

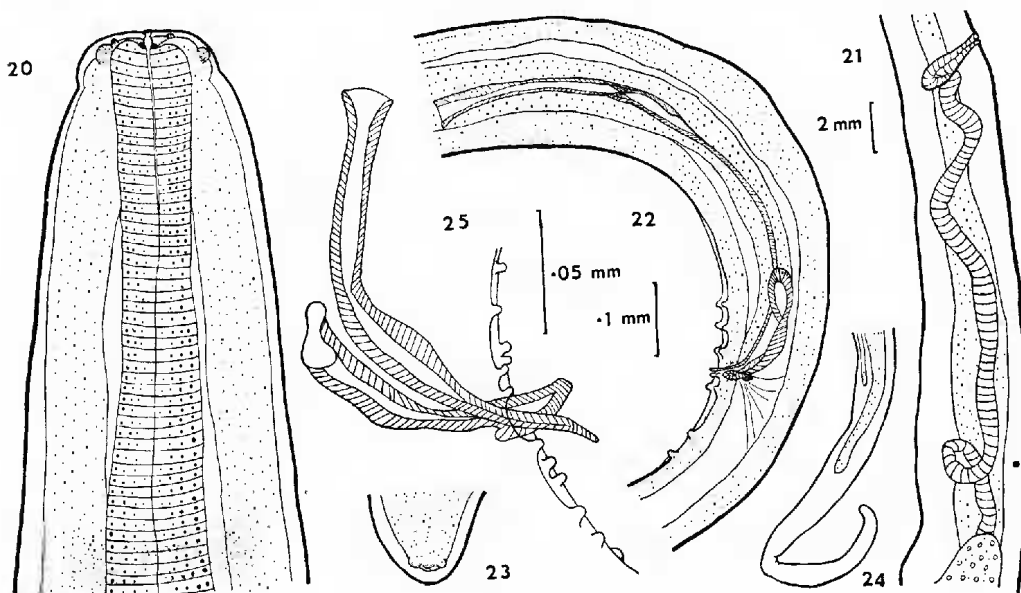
- (1) *Dipetalonema spelaea* (Leidy); found in the body cavity of *Petrogale penicillata*. Synonyms: *Filaria spelaea* Leidy, 1875; *F. australis* Linstow, 1897; *Setaria spelaea* Railliet and Henry, 1911; *Acanthocheilonema spelaea* Walton, 1927; *Dipetalonema australe* Boulenger, 1928.
- (2) *Dipetalonema trichosuri* (Breinl); found in the body cavity of *Trichosurus vulpecula*. Synonyms: *Filaria trichosuri* Breinl, 1913; *Acanthocheilonema australe* Baylis, 1925; *Breinlia trichosuri* Yorke and Maplestone, 1926.

We have also found males corresponding to Linstow's and to Boulenger's description from the subcutaneous tissues of *Dendrolagus benettianus*, a tree kangaroo from North Queensland.

Parasites belonging to *Dipetalonema spelaea* are long thin worms with rounded anterior end and tapering tail. The cuticle is marked with definite transverse striations which are close together. The male is about 11 to 12 cms. long, with maximum diameter of 0.32 mm.; the female is 23 to 24 cms. long with a maximum diameter of 0.66 mm. There are two large and four small papillae on the anterior end; the mouth leads to a short vestibule surrounded by a chitinous ring. The oesophagus is not divided into two parts; in the male it is 1.9 mm.

and in the female 1.55 mm. long. The nerve ring is about 0.246 mm. from the anterior end in the male, and 0.28 mm. in the female. The intestine is rather narrower than the oesophagus and is straight. The tail is long, 1.3 mm. in the female, 0.86 mm. in the male.

The spicules are unequal, the longer, 1.01 mm., is cylindrical proximally, and then flattened out, the distal half of its length being needle-like, curved and tapering. The smaller is about a quarter of its length, *i.e.*, 0.25 mm., and has a massive proximal part and a spatulate distal part rolled at the edges. There is



Figs. 20-25

Figs. 20-24 *Dipetalonema spelaea* 20, male, anterior end; 21, vulva; 22, male, cloacal region; 23, tip of male tail; 24, female tail

Fig. 25 *Dipetalonema trichosuri* Cloacal region Figs. 20, 23 and 25; 21 and 24 to same scale

an accessory piece projecting back from the distal end. Only three pairs of pre-anal and three pairs of post-anal papillae were distinguished. The tail is in a spiral of two or three turns.

The vulva is 5.1 mm. from the anterior end, and is associated with a pyriform muscular bulb from which the vagina leads back, more or less coiled according to the age of the specimen, to the uterus which divides into the two branches after a short distance (1.7 mm.). It is opisthodelphous. The ovarian tubes do not extend to the anal region.

This species is somewhat like *Filaria trichosuri* but is distinguished from it by the length of the major spicule and the position of the vulva, which in Breinl's specimens is further forward.

It differs from *F. dentifera* Linstow in the absence of a dorsal head-papilla, relative sizes of the spicules, and the position of the vagina.

In general anatomy and measurements the present specimens are to be identified with Linstow's *F. australis*, although only three pre-anal and three post-anal papillae have been detected. The female of *F. spelaea*, as described by Walton 1927, agrees with *F. australis*, so Leidy's specific name should, as Walton points out, take precedence. As the specific name is the plural of a Latin substantive and not an adjective, we have not altered it to agree with the genus.

Eisig (Z. f. wiss. Zool., 20, 1870, 99-102) gave an account of *Filaria* sp. from the pericardium of *Halmaturus bennetti* in the Heidelberg Zoological Gardens. Only females, 90-100 mm. in length, were present. There were stated to be two rows of papillae, each with six, at the head end, and the oesophagus was reported to be one-fortieth of the total length. One of us has pointed out (Johnston, 1909, 518) that the host is a Tasmanian wallaby, *Macropus ruficollis* var. *bennettii*. The arrangement and number of the head papillae prevent us from assigning the species to any of the filariids described from Australian marsupials. *D. roemeri* and *D. tenue* seem to be nearest.

DIPETALONEMA TRICHOSURI (Breinl)

Fig. 25

We have examined many specimens of this species from the common opossum, *Trichosurus vulpecula*, from Queensland, including a female from Breinl's type material, and find them to agree with Breinl's *F. trichosuri* in every way except that there appears to be only one pair of subterminal papillae and the tail ends in a small median papilla. It is to be distinguished from *D. spelaea* by the position of the vulva and the relative lengths of the spicules; and from *F. dentifera* by the absence of dorsal head-papilla, in the shape of the spicules, and in the number of cloacal papillae. The spicules of this species are shown in fig. 25.

Yorke and Maplestone (1926, 400) published figures (fig. 273) and made the species the type of a new genus *Breinlia*, but Baylis (1934, 551) and subsequent workers regard the latter as a synonym of *Dipetalonema*.

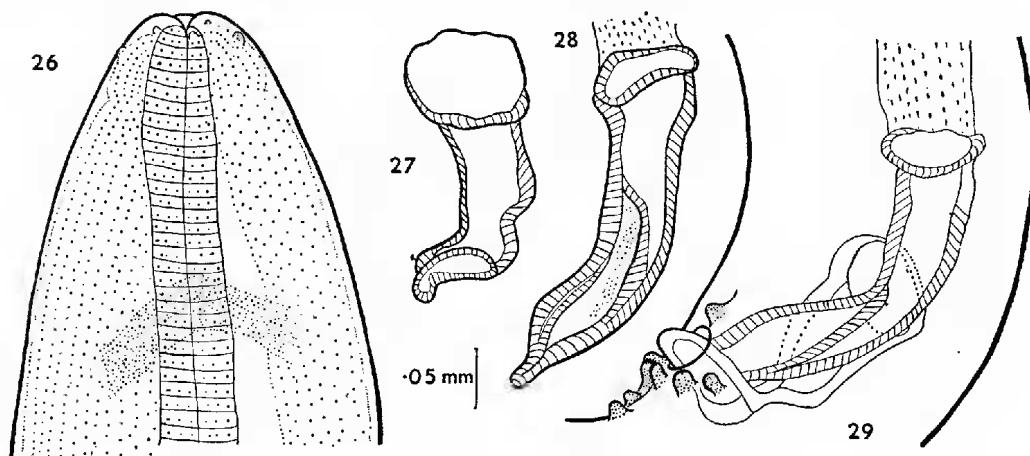
Scott (P.Z.S., 1926, 237) reported finding filarial larvae in an opossum, *Pseudochirus lemuroides*, in the London Zoological Gardens. The habitat of the host is north-eastern Central Queensland. Linstow (1898, 460) described *Filaria dentifera* from the body cavity of *Phalangista* (= *Trichosurus*) *vulpecula*, collected by Semon in Queensland—probably in the Burnett River district. Stiles and Hassall (Index Cat. Med. Vet. Lit. Roundworms, 1920, 466) have, in error, quoted the host as *Trichiurus vulpecula*. The parasite has not been satisfactorily placed generically.

Dipetalonema annulipapillatum n. sp.

Figs. 26-29

Only males of this species were found; specimens being obtained from the knee joint of *Macropus dorsalis*, the coelome of *M. ualabatus* and the subcutaneous tissue of *Onychogale frenata*.

It is a long thin worm, 5 to 7 cms. long, and with a maximum breadth of 0·2 to 0·3 mm.; the tail is coiled in a tight spiral of four to six turns; the anterior and posterior ends are rounded, the anterior having two lateral epaulette-like structures, and the posterior with a median terminal and two subterminal papillae. The tail is about 1·1 mm. long. The papillae on the anterior end are difficult to distinguish, but there appear to be two large laterals and four smaller ones around the mouth. The nerve ring is about 0·25 to 0·27 mm. from the anterior end. The mouth is situated in a depression at the anterior end; the oesophagus is 1·6 to 2 mm. long, and the intestine, starting with a slight bulge, is narrower.



Figs. 26-29

Figs. 26-29 *Dipetalonema annulipapillatum* 26, male, anterior end; 27, shorter spicule; 28, longer spicule; 29, cloacal region. All figs. to same scale

The testis tubule begins just posterior to the commencement of the intestine. The vas deferens can be traced to the beginning of the cylindrical proximal end of the larger spicule. The latter is about 0·4 mm. long, and the distal part is spatulate with rolled edges, and ends in a blunt point. The shorter spicule is 0·3 mm. long and is broad and spatulate, forming a groove for the longer. The cloacal region is somewhat elevated and with it are associated several papillae arranged in a ring, consisting of three pairs of peri-anal, one pair of post-anal, and one pair of pre-anal. This is a different arrangement from that in any species of *Dipetalonema* described hitherto.

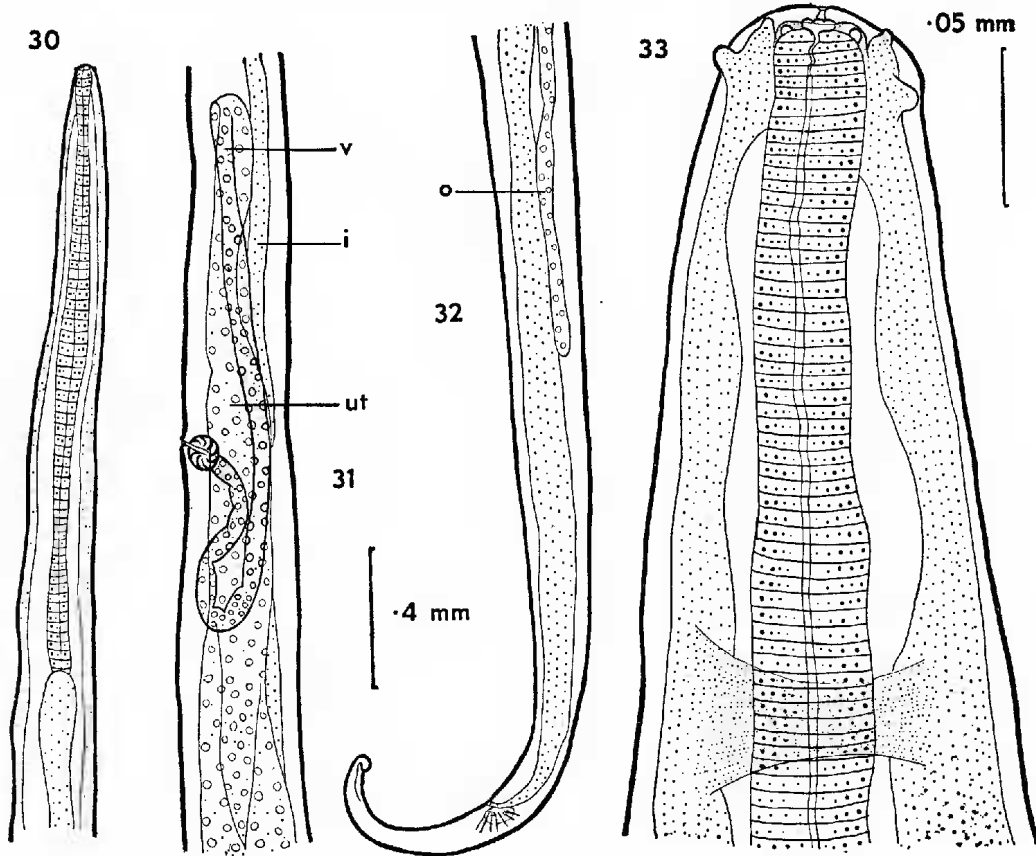
Dipetalonema tenue n. sp.

Figs. 30-33

Some female filarial worms not agreeing with any previously described species were found among the viscera of two specimens of the euro, *Macropus robustus*. They are exceedingly long and thin, 20 to 30 cm. long and 0·59 to 0·65 mm. wide. The head is rounded, bears one pair of large lateral and four (?) smaller papillae, and is 0·086 to 0·069 mm. wide. The nerve cord is about 0·27 mm.

from the anterior end. The oesophagus is simple, 2 to 2.9 mm. long, and is followed by a straight intestine of about the same width, though the part immediately following the oesophagus may be somewhat dilated. The anus is 0.75 to 1.25 mm. from the posterior end. The tail tapers and is curved, the end being bluntly pointed; there are two very small subterminal papillae.

The ovarian tubes do not extend to the anal region. The two uteri pass forward to the region of the vulva, where they are united into a single uterus



Figs. 30-33

Figs. 30-33 *Dipetalonema tenue* 30, female, anterior end; 31, region of vulva; 32, female, posterior end; 33, female, anterior end. Figs. 30-32 to same scale

which passes forward almost to the beginning of the intestine and then enters the vagina which leads back to the vulva. The distance from the anterior end to the vulva is one twenty-seventh to one thirty-fourth of the total body length.

The larvae are not enclosed in shells; as they grow older they elongate and uncurl in the uteri. The younger are 0.07 by .01 mm., the older 0.246 by .225 mm.

This worm differs from *D. spelaea* and *D. trichosuri* in the position of the vulva, which is much further back, and in the position of the nerve ring.

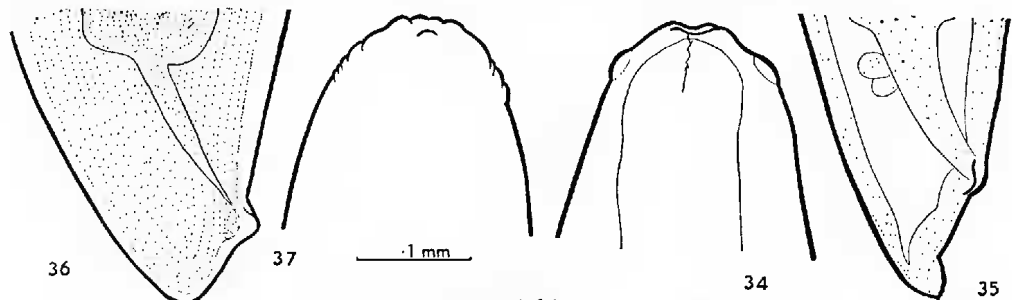
It differs from *Filaria dentifera* in the absence of a dorsal head-papilla; from *D. capilliforme* in the position of the vulva which is much further back, and in the arrangement of the papillae on the head (*D. capilliforme* does not appear to have the two large lateral papillae); and from *D. dendrolagi* Solomon in the length of the body and the size of the larvae.

FILARIA (s.l.) spp.

The following specimens have not been fully examined because they could not be cleared sufficiently:

(1) A female from the coelome of a "native cat," *Dasyurus maculatus*, short and thick, 65 mm. by 0.963 mm. The head is rounded, 0.154 mm. wide, and has four peri-oral and two large and low lateral papillae. The intestine narrows a short distance before the anus. The tail is short and bluntly pointed, 0.154 mm. long, and ends in a narrower part like a huge papilla (figs. 34-35).

(2) From the peritoneum of *Trichosurus caninus*: two worms were found which, judged by the absence of specialization in the anal region, are females. They are about 7 cm. long, 0.88 mm. in thickness. There are four to six peri-oral papillae. The head is 0.15 mm. across (fig. 36). The tail is short, in one specimen ending in an elongated portion, like the one described above. The anus lies between two papillae, 0.099 mm. from the tip of the tail (figs. 36-37).



Figs. 34-36

Figs. 34-35 *Filaria* (s.l.) sp. from *Dasyurus maculatus*

Figs. 36-37 *Filaria* (s.l.) sp. from *Trichosurus caninus*

(3) From the liver of *Potorous tridactylus*: a single worm was found, 7 cm. long and 1.5 mm. wide—though the width may be less as the worm was split. The head is rounded, 0.12 mm. across, and followed by a constriction 0.09 mm. from the anterior end. The tail is bluntly pointed. No peri-oral papillae can be seen, nor can any details of the anatomy be distinguished.

We record the occurrence of *Dipetalonema* sp. in the knee joint or in the coelome of the rock wallaby (*Petrogale xanthopus* Gray), euro (*Macropus robustus* Gould), and kangaroo (*Macropus major* Shaw) of the northern Flinders Ranges and adjacent regions in South Australia, but, unfortunately, specimens are not now available to determine whether they belong to *D. roemeri* or *D. spelaea*, or to both.

BIBLIOGRAPHY

- BANCROFT, T. L. 1893 Entozoal Parasites. Austr. Med. Gaz., 12, 258-260
- BAYLIS, H. A. 1925 Notes on some Australian Parasitic Nematodes. Ann. Mag. Nat. Hist., ser. 9, 15, 112-115
- BAYLIS, H. A. 1934 On two Filariid Parasites of Marsupials from Queensland. Ann. Mag. Nat. Hist., ser. 10, 13, 549-554
- BOULENGER, C. L. 1928 Report on a collection of Parasitic Nematodes, mainly from Egypt. Part v, Filarioidea. Parasitol, 20, 32-55
- BREINL, A. 1913 Nematodes observed in North Queensland. Austr. Inst. Trop. Med. Rep. for 1911, 39-46
- COBBOLD, T. S. 1879 Parasites, a Treatise on the Entozoa of Man and Animals. London.
- JOHNSTON, T. H. 1909 The Entozoa of Monotremata and Australian Marsupialia, pt. i. Proc. Linn. Soc. N.S.W., 34, 514-523
- JOHNSTON, T. H. 1911 The Entozoa of Monotremata and Australian Marsupialia, pt. ii. Proc. Linn. Soc. N.S.W., 36, 47-57
- JOHNSTON, T. H. 1916 A Census of the Endoparasites recorded as occurring in Queensland, arranged under their hosts. Proc. Roy. Soc. Qld., 28, 31-79
- LEIDY, J. 1875 On some Parasitic Worms. Proc. Acad. Nat. Sci. Philad., 27, 17-18
- LINSTOW, O. 1897 Zur Systematik der Nematoden nebst Beschreibung neuer Arten. Arch. Mikr. Anat., 49, 608-622
- LINSTOW, O. 1898 Nemathelminthen von Herrn Richard Semon in Australien gesammelt. Semon's Forschungsreisen in Australien (v). Denk. Med. Nat. Ges., Jena, 8, 469-471
- LINSTOW, O. 1905 Helminthologische Beobachtungen. Arch. f. Mikr. Anat., 66, 355-366
- OLDHAM, J. N. 1933 The Helminth Parasites of Marsupials. Jour. Helm., 11, 195-256
- PLIMMER, H. G. 1912 (a) On the Blood Parasites found in Animals in the Zoological Gardens during the four years 1908-1911. P.Z.S., 406-419
- PLIMMER, H. G. 1912 (b) On certain Blood Parasites. Jour. Roy. Micr. Soc., 133-150
- SOLOMON, S. G. 1933 Note on a new Species of *Breinlia* from a Tree Kangaroo. Jour. Hclm., 11, 101-104
- THWAITE, J. W. 1927 The Genus *Setaria*. Ann. Trop. Med. Parasit., 21, 427-466
- YORKE, W., and MAPLESTONE, P. A. 1926 The Nematode Parasites of Vertebrates. London
- WEHR, E. E. 1935 A revised Classification of the Nematode Superfamily Filarioidea. Proc. Helm. Soc., Washington, 2, 84-88